CLAIMS

We claim:

1. A computer system comprising one or more memories, one or more central processing units and further comprising:

one or more input devices for receiving one or more input meshes representing a three dimensional model, the three dimensional model capable of being represented as a 2-manifold polygon mesh; and

a conversion process that automatically converts the input mesh to a multiresolution quadrilateral-based subdivision surface (MQSS) representation.

2. A computer system comprising one or more memories, one or more central processing units and further comprising:

one or more input devices for receiving one or more input meshes representing a three dimensional model, being a 2-manifold polygon mesh, each of the input meshes having one or more features, each of the features being a part of the model with a different curvature and scale than one or more adjacent parts; and

a conversion process that automatically converts the input mesh to a multiresolution quadrilateral-based subdivision surface (MQSS) representation.

3. A system, as in claim 1, where the system further comprises one or more of the flowing: an output for displaying the MQSS, a process for storing the MQSS in one or more of the memories.

4. A computer system comprising one or more memories, one or more central processing units and further comprising:

one or more input devices for receiving one or more input meshes representing a three dimensional model, each input mesh being a 2-manifold polygon mesh, each of the input meshes having one or more features, a feature being a perceptually important part of the model with a different curvature than one or more adjacent parts; and

a conversion process that automatically converts the input mesh into a multiresolution quadrilateral-based subdivision surface (MQSS) having a base mesh with one or more base mesh edges where one or more of the base mesh edges correspond to one of the features.

5. A computer system, as in claim 4, where the MQSS is used for one or more of the following: model editing, compression of the input mesh, a network transmission, model storage, a level of detail representation, an input model parameterization.

6. A computer system, as in claim 4, where the base mesh is one or more of the following: a parameterization domain for the input model, a coarse approximation of the input model, a texture mapping domain.

7. A computer system, as in claim 4, where the feature is one or more of the following: a perceptually salient ridge on the input model, a perceptually salient ravine on the input model, a perceptually salient crease, a perceptually salient curve, or some other perceptually salient element.

8. A computer system, as in claim 4, where the conversion process comprises the steps of:

a. generating an atlas decomposition of the input mesh by using an atlas generation process;

b. extracting a quadrilateral base mesh using a quadrilateral mesh extraction process, the atlas, and the input mesh; and

c. extracting the MQSS with one or more levels from the input mesh and the quadrilateral base mesh.

9. A computer system, as in claim 4, where the atlas generation process comprises the steps of:

a. selecting a seed set of one or more chart seeds;

b. computing a constrained centroidal Voronoi decomposition of the input mesh around the chart seeds, the constrained centroidal Voronoi decomposition having one or more cells;

c. splitting the cells that do not satisfy a height field approximation criterion into height fields resulting in a partition of the input mesh comprising one or more regions that are approximate height fields; and

d. splitting each region that does not satisfy a compact shape criterion into one or more subregions that are approximately convex and homeomorphic to discs, resulting in the atlas that is a refined decomposition of the input mesh comprising one or

more charts, each chart being one of the approximate height fields each chart being approximately convex and homeomorphic to a disc.

10.A computer system, as in claim 9, further comprising the step of:

adjusting one or more boundaries between one or more pairs of charts.

11.A computer system, as in claim 9, where the selecting the seed set is a random process.

12.A computer system, as in claim 11, where the selecting the seed set is done by performing a seed selection process comprising the following steps:

a. computing colors for the faces of the input mesh from the information provided by the mesh normals;

b. applying an optional smoothing to colors to reduce noise;

c. applying a color quantization procedure to identify regions of relatively constant shape over the input mesh;

d. further adjusting the relatively constant shape regions by optionally straightening the boundaries between them; and

e. computing an approximate medial axis for each of the relatively constant shape regions and extracting a small set of medial axis samples from regions and letting the seed set be the union of these samples.

13.A computer system, as in claim 12, where the color quantization process comprises the following steps:

a. selecting a set of representative colors; and

b. applying a color classification procedure into classes corresponding to the set of representative colors.

14. A computer system, as in claim 8, where the quadrilateral mesh extraction process comprises the steps of:

a. extracting a boundary set of one or more boundaries curves between one or more charts in the atlas; and

b. for each of the charts, creating a polygonal approximation of the chart, by simplifying one or more boundary curves corresponding to the charts, resulting in a coarse polygonal mesh.

15. A computer system, as in claim 13, further comprising the step of:

c. removing unnecessary faces and edges of the coarse polygonal mesh.

16. A computer system, as in claim 13, further comprising the step of:

c. quadrangulating the coarse polygonal mesh if the coarse polygonal mesh is not a quadrilateral mesh.

17. A method of converting a 2-manifold polygon mesh into a multiresolution qualdrilateral subdivision surface, the method comprising the steps of:

a. generating an atlas decomposition of the input mesh by using an atlas generation process;

b. extracting a quadrilateral base mesh using a quadrilateral mesh extraction process, the atlas, and the input mesh;

and

c. extracting the MQSS with one or more levels from the input mesh and the quadrilateral base mesh.

18. A system for converting a 2-manifold polygon mesh into a multiresolution qualdrilateral subdivision surface, the system comprising:

a. means for generating an atlas decomposition of the input mesh by using an atlas generation process;

b. means for extracting a quadrilateral base mesh using a quadrilateral mesh extraction process, the atlas, and the input mesh; and

c. means for extracting the MQSS with one or more levels from the input mesh and the quadrilateral base mesh.

19. A computer program product for converting a 2-manifold polygon mesh into a multiresolution qualdrilateral subdivision surface, the computer program having a method comprising the steps of:

a. generating an atlas decomposition of the input mesh by using an atlas generation process;

b. extracting a quadrilateral base mesh using a quadrilateral mesh extraction process, the atlas, and the input mesh; and

c. extracting the MQSS with one or more levels from the input mesh and the quadrilateral base mesh.